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THE SPLEEN

A

PERMANENT PLACENTA:

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TEMPORARY SPLEEN.

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> "Philosophi enim veri, qui amore veritatis et sapientiæ flagrant, nunquam se tam σοφὸς, sapientiâ plenos reperiunt, aut suo sensu abundant, quin veritati, à quocunque et quandocunque venerit, locum dent; nec tam angusti animi ut credant quamvis artem aut scientiam adeo omnibus numeris absolutam et perfectam à veteribus traditam, ut aliorum industriæ et diligentiæ nihil sit reliquum: quum profiteantur plurimi, maximam partem eorum quæ scimus, eorum quæ ignoramus, minimam esse. Nec ita traditionibus et præceptis quorumcumque addicti, inservire se patiuntur philosophi, et libertatem perdunt, ne oculis propriis fidem adhibeant. Nec ita in verba jurant antiquitatis magistræ, ut veritatem amicam in apertis relinquant et in conspectu omnium deserant. Sed sicut credulos et vanos omnia primâ facie admittere et credere; ita manifesta sensui non videre, et luce meridianâ diem non agnoscere stupidos et insensatos pariter existimant; et non minus poëtarum fabulas, et vulgi deliramenta, quàm scepticorum epochen, in via philosophica declinare docent."—Harvey de Motu Cordis, 1639.

1. The Circulation of the Blood comprises *three* distinct and perfect vascular systems—an *hepatic*, a *pulmonary*, and a *general;* and not as Harvey taught, and as at present believed only two—a pulmonic, and a systemic.

2. It is erroneous to regard the hepatic vascular system as a mere part or dependency of the general vascular system; or to suppose that the propulsion of the blood through the hepatic system is effected by the same agent as propels the blood through the general system; or, in other words, to believe that the left ventricle, which propels the blood through the arteries, capillaries, and veins of the general system into the right auricle by the superior and inferior venæ cavæ, is also the agent which propels the blood through the hepatic system into the right auricle by the cavæ hepaticæ: for, as there are *three* perfect vascular systems com-

prised in the Circulation of the Blood, there are THREE GRAND AGENTS concerned in its propulsion—one for each system; and instead of the hepatic system being dependent on the left ventricle for the propulsion of the portal blood, the left ventricle is actually indebted to the agent which propels the blood through the hepatic system for returning a portion of blood to the right side of the heart; that portion is, the blood supplied to the digestive organs by the cœliac and mesenteric arteries.

3. The First, or *hepatic vascular system* consists of—1, the SPLENO-HEPATIC VEIN—under which term is included the splenic vein and its roots or *Spleen,* and the portal vein and its branches, or the sub-hepatic veins; 2, the portal plexuses, or hepatic capillaries; and 3, the supra-hepatic veins.

4. The Second, or *pulmonary vascular system* consists of—1, the right auricle; 2, the right ventricle; 3, the pulmonary artery and its branches; 4, the pulmonary capillaries; and 5, the pulmonary veins.

5. The Third, or *general vascular system* consists of—1, the left auricle; 2, the left ventricle; 3, the aorta and its ramifications; 4, the capillaries in every part and organ except the liver and lungs; and 5, all the veins except the spleno-hepatic, the supra-hepatic, and the pulmonary.

6. Each of the three vascular systems possesses—1, a recipient cavity; 2, a propulsive agent; 3, an afferent trunk and ramifications; 4, capillary vessels: and 5, efferent vessels and their trunks.*

7. The *recipient cavity* in the hepatic vascular system is the *Spleno-hepatic Vein;* in the pulmonary system the right auricle; and in the general system the left auricle.

8. The *propulsive agent* in the hepatic vascular system is the *Spleno-hepatic Vein;* in the pulmonary system, the right ventricle; and in the general system, the left ventricle.

9. The *afferent trunk and ramifications* in the hepatic vascular system are the *Spleno-hepatic Vein;* in the pulmonary system the pulmonary artery and its branches; and in the general system, the aorta and its branches.

10. Thus the SPLENO-HEPATIC VEIN is in the hepatic vas-

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* *Affero,* I bring to, or in; *effero,* I carry out, or from.

cular system the recipient cavity, or *auricle ;* the propulsive agent, or *ventricle ;* and the afferent vessel, or *artery.* It performs the duties of *auricle, ventricle,* and *artery ;* and yet it is essentially a Vein !

11. The *capillaries* in the hepatic vascular system are the *portal plexuses;* in the pulmonary system, the capillaries of the lungs; and in the general system, the capillaries in all parts and organs *except* the liver and lungs.

12. The *efferent vessels and their trunks* are in the hepatic system the supra-hepatic veins; in the pulmonary system, the pulmonary veins; and in the general system all the veins *except* the spleno-hepatic, the supra-hepatic, and the pulmonary.

13. It has been known since the Discovery of the Circulation that the two auricles are recipient cavities, the two ventricles propulsive agents, the trunks and branches of the pulmonary artery and aorta afferent vessels, and the pulmonary veins, superior and inferior venæ cavæ, venæ cavæ hepaticæ, and their tributary roots efferent vessels ; but it has not heretofore been remarked that *the hepatic vascular system is a distinct, perfect, and* INDEPENDENT *system ;* or that the *spleno-hepatic vein* is in that system both recipient cavity or auricle, and propulsive agent or ventricle, as well as the afferent vessel or artery.

14. That the hepatic system is an independent system, and not a mere part or dependency of the general system, is indicated first by the portal trunk dividing into branches, the subdivisions of which ultimately become capillaries, just as the pulmonary artery and aorta divide into branches which ultimately become capillaries: secondly, by the circumstance of the portal plexuses being the *second* system of capillaries through which blood propelled by the left ventricle through the cœliac and mesenteric arteries and their branches has to pass before it can re-enter the right auricle. But there is no reason why the hepatic system should be regarded as a mere part or dependency of the general system; or rather a part *of* a part of the general system, which it is if not a perfect and independent system in itself. Nor can any reason be given why the vessels which proceed

to and from the LIVER should belong to a less perfect and independent system than those which proceed to and from the LUNGS: nor why the blood which has to be propelled *vertically* through the liver is not in need of an appropriate agent for its propulsion, while the blood which is propelled *horizontally* through the lungs requires a very powerful one, the right ventricle. But the *proof* that the hepatic system *is* an independent system, and under no more obligation to the left ventricle than the pulmonary system, is a fact shortly to be pointed out; which will shew that if the hepatic system were *not* an independent system, or in other words, if it could not propel its own blood through its own vessels, the blood would never get through at all; for it proves that the left ventricle can no more propel the blood through the hepatic system, than the spleno-hepatic vein can propel it through the pulmonary system, or the right ventricle through the general system.

15. No doubt is entertained that the right ventricle, *per se*, is fully able to propel, and does propel the blood through the trunk and branches of the pulmonary artery, the capillaries of the lungs, and the pulmonary veins, into the left auricle: and few will be disposed to deny that when the body is at rest in the horizontal position, and the motion of the blood therefore neither accelerated nor retarded by muscular action or gravitation, the blood is propelled through the arteries, capillaries, and veins of the general system *solely* by the left ventricle. But it is erroneous to suppose that *all* the blood propelled by the left ventricle through the arteries, capillaries, and veins of the general system, is propelled by the left ventricle into the right auricle; for a *part* of it already alluded to, namely, the blood supplied to the digestive organs by the cœliac and mesenteric arteries, the left ventricle propels *into* the hepatic system—that is, into the *spleno-hepatic vein*, in which vein the splenic artery, and the gastric, duodenal, and mesenteric veins terminate—but not *through* that system as is at present believed; for, as before stated, and as will just now be proved, the left ventricle can no more propel the portal blood through the liver, than the spleno-hepatic vein can propel the blood through

the lungs, or the right ventricle propel it through the arteries, capillaries, and veins of the *general* system.

16. The pulmonary is the second in order of the three systems, being placed between the hepatic which is the first, and the general which is the last; and both the hepatic and general systems propel blood into its recipient cavity. The hepatic system propels all its blood into the recipient cavity of the pulmonary system, or right auricle; the pulmonary system propels all its blood into the recipient cavity of the general system, or left auricle; but the general system propels blood into the recipient cavities both of the hepatic and pulmonary systems—into the former (the *spleno-hepatic vein*) through the splenic artery, gastric, duodenal, and mesenteric veins,—and into the latter (the right auricle) through the superior and inferior venæ cavæ.

17. The spleno-hepatic vein is the recipient cavity of the hepatic system, for it receives not only all the blood which is supplied to the digestive organs by the cœliac and mesenteric arteries,* but also *all the fluids which are taken into the stomach, every ounce of which must enter the spleno-hepatic vein, and pass through the three systems of the Circulation in their natural order of hepatic, pulmonary, and general.*†

18. It is very commonly believed that the fluids received into the stomach pass in part not merely into the duodenum but an indefinite distance further into the digestive tube, and are then taken up from the mucous surface of the stomach, duodenum, and jejunum, by the absorbents or lacteals, to be conveyed along the thoracic duct into the left subclavian vein. But the experiments of Magendie, Ségalas, and others, have long since proved that the fluids pass at once into the veins, and without the assistance or intervention of the absorbents: for those experiments shew that fluids impregnated with certain salts, such as the ferro-prussiate of potash, can be detected very shortly after they have entered the stomach in the blood and urine, but not in the chyle or contents of the thoracic duct; and, again, that fluids disappear

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* The hepatic artery is no exception, for its capillaries end in the portal plexuses.

† Reasons will be given hereafter for believing that the solids also take this course.

from the stomach and find their way into the Circulation just as rapidly after the thoracic duct has been tied as before. But no experiments ought to have been needed to convince us that the *veins* absorb; or that the fluids pass direct into the veins. A knowledge of the course, calibre, and termination of the *thoracic duct* ought to be sufficient to convince any reasonable being that *it* cannot possibly be the channel through which the fluids enter the Circulation; and therefore that they must pass from the stomach and duodenum, but chiefly from the former, into the *veins;* and, as all the veins both of the stomach and duodenum terminate in the splenic vein, that the fluids necessarily pass through the gastric and duodenal veins into the splenic.

19. The series of channels through which the fluids pass which are eliminated by the kidneys are as follows: 1, the mouth; 2, the pharynx; 3, the œsophagus; 4, the stomach and duodenum; 5, the gastric and duodenal veins; 6, the splenic vein; 7, the portal trunk and branches; 8, the portal plexuses; 9, the roots and trunks of the hepatic veins; 10, the top of the inferior cava; 11, the right auricle; 12, the right ventricle; 13, the pulmonary artery and its branches; 14, the capillaries of the lungs; 15, the roots and trunks of the pulmonary veins; 16, the left auricle; 17, the left ventricle; 18, the aorta to the renal arteries; 19, the renal arteries; 20, the capillaries of the kidneys; 21, the ureters; 22, the bladder; 23, the urethra.

20. As the fluids which are taken into the stomach pass through the gastric and duodenal veins to enter the splenic vein, they get *into* vessels belonging to the general system, before they pass *into* the hepatic system. They, however, pass *through* the hepatic vascular system before they pass *through* the pulmonary system, and *through* the pulmonary system before they pass *through* the general system: and therefore it is proper to regard the hepatic as the *first* of the three vascular systems, the pulmonary as the *second,* and the general as the *third.*

21. The contents of the spleno-hepatic vein consist, firstly, of blood from the splenic artery, which enters the spleno-hepatic vein at its commencement, and in which blood no

change is effected by passing from the splenic artery into the roots of the spleno-hepatic vein, or spleen; secondly, of blood from the stomach, duodenum, and pancreas, which enters the spleno-hepatic vein by the gastric and duodenal veins; thirdly, of the fluids of whatever kind which have been received by the stomach, and which also pass through the gastric and duodenal veins; fourthly, of blood from the jejunum, ileum, colon, and rectum, which enters the spleno-hepatic vein by the mesenterics; and fifthly, of blood from the omenta and gall-bladder.

22. The *portal blood,* under which term is included the general contents of the spleno-hepatic vein, is composed therefore of oxygenised blood from the splenic artery, and carbonised blood received from the stomach and intestines, pancreas and gall-bladder, diluted with the fluids of whatever kind which have been received by the stomach.

23. Owing to the fluids passing from the stomach into the spleno-hepatic vein, the portal blood is not only a more or less diluted blood, but its composition is also subject to great and frequent variation. With its composition however, at least *chemically,* we are not now concerned. That belongs properly to the Physiology of the Liver, or Sanguification,—a subject which will remain obscure until it is known what takes place in the hepatic capillaries; and in what respects the blood contained in the hepatic veins differs from the portal blood before it has been propelled through the portal plexuses, and the bile eliminated. Our object has already been defined. It is not chemico-vital, but mechanico-vital. We have nothing to do with the function of the liver, but have merely undertaken to shew that the hepatic vascular system is a perfect and independent system; and that the spleno-hepatic vein is in that system the recipient cavity or auricle, and the propulsive agent or ventricle, as well as the afferent vessel or artery.

24. Sufficient has already been said to shew that the spleno-hepatic vein is the recipient cavity or auricle; and, as it divides and subdivides after the manner of arteries, its branches ultimately terminating in capillaries, the portal plexuses, in like manner as the ramifications of the pulmo-

nary artery terminate in the capillaries of the lungs; and, again, as the blood is received from the portal plexuses by the hepatic veins, just as the blood is received from the pulmonary capillaries by the pulmonary veins,—it is obvious that the spleno-hepatic vein performs the duty of afferent vessel or artery, and also that the hepatic vascular system is a complete system. It remains then to be proved that the hepatic system is also an *independent* system,—that is, that it is not indebted to the left ventricle for the propulsion of its blood; but that the spleno-hepatic vein is really and truly the *propulsive agent* or ventricle, as well as recipient cavity or auricle, and afferent vessel or artery.

25. The hepatic vascular system is not only regarded by most physiologists as a dependent system, or rather as a *part* of the general system, but it has been supposed by some to be dependent on the pulmonary as well as on the general system; that is, that the left ventricle and the right auricle manage to get the blood through the liver between them; the left ventricle as it were pushing the blood from behind, and the right auricle pulling at it in front. The opinion however almost universally entertained is, that it is the *vis à tergo* of the left ventricle which propels the portal blood through the liver: and this is the opinion which it is necessary to refute. It has been already shewn that there is no other course for the fluids received by the stomach to take, than through the gastric and duodenal veins into the *spleno-hepatic vein:* it follows, therefore, that not only is the portal blood a more or less diluted blood, but that *much more diluted blood enters the heart by the hepatic veins, than there is arterial blood supplied to the digestive organs by the cœliac and mesenteric arteries.* This is the fact to which allusion has before been made as proving that the left ventricle is totally incapable of propelling the portal blood through the hepatic system; and a more positive and convincing proof than it is could not be adduced in refutation of an erroneous opinion; for it shews that *if the left ventricle were the agent in the propulsion of the portal blood, it would be necessary for it to be able by propelling a certain quantity of blood* (say one ounce) *into the cœliac and mesenteric*

arteries, to drive a greater quantity (say ten drachms) *through the three divisions of the hepatic system into the right auricle;* that is, through the sub-hepatic veins, the portal plexuses, and supra-hepatic veins. Now this is plainly as impossible as for a power to overcome a resistance greater than itself: and therefore nothing can be more certain than that the left ventricle is not the agent in the propulsion of the portal blood.

26. With regard to the opinion that the *right auricle* either assists, or is the chief agent in getting the blood through the hepatic system:—The advocates of this opinion assume that the right auricle has not only a power of contraction by which it propels its contents into the right ventricle, but also a power of dilatation or expansion which produces a "*tendency to a vacuum*;" and they imagine that this tendency to a vacuum has the effect of pumping the blood out of the hepatic veins, and therefore through the liver. The fitting objection to this sagacious opinion is, that if expansion of the right auricle is capable of pumping blood through the LIVER which is *below* the heart, expansion of the left auricle ought to be able to pump blood through the LUNGS which are placed one on *each side* the heart: and that if no peculiar agent *is* needed to propel the blood through the liver, neither *ought* any to be required to propel it through the lungs, and that the right ventricle must therefore be superfluous.

27. It has been supposed by some physiologists that the motion of the diaphragm and the abdominal muscles during respiration renders important assistance in the propulsion of the blood through the liver. The *importance* of that assistance may be estimated from the circumstance of the blood being propelled through the liver *before* birth, when there is no respiration, as well as after.

28. From the preceding observations it appears evident that the hepatic system is under the *necessity* of propelling its own blood through its own vessels. It has been shewn to be a complete system, possessing an afferent vessel and branches, capillaries, and efferent vessels and trunks. It has also been shewn that the spleno-hepatic vein is recipient

cavity or auricle, as well as afferent vessel or artery. It has moreover been proved that neither the left ventricle nor the right auricle nor yet respiration propels the blood through the hepatic system; and as there is nothing else than the spleno-hepatic vein *to* propel it, we need not doubt and hesitate, and say, *it may be this, or it may be that,—or that this may do a little,* and *that may do a little,—or that the left ventricle and the right auricle, and respiration may manage it by their combined efforts;* for it is plain the SPLENO-HEPATIC VEIN itself must propel the blood and fluids which it receives from the splenic artery, gastric, duodenal, and mesenteric veins, through the three divisions of the hepatic system.

29. With our present ideas concerning the Circulation and propulsion of the Blood, it does undoubtedly at first sight appear a strange and striking anomaly for a VEIN to perform the triple function of *auricle, ventricle,* and *artery.* We *see* that it officiates as an artery or afferent vessel by its dividing and subdividing and terminating in capillaries after the manner of the pulmonary artery and aorta; and we have become so familiar with the fact that it does not even strike us as being at all extraordinary. It will however on reflection appear hardly less strange that a *vein* should divide and subdivide and terminate in capillaries, and so perform the duty of an artery, than that it should officiate as auricle or ventricle, or both.

30. Presumptive evidence has but little weight in Physiology, or it might be asked,—If the spleno-hepatic vein performs the duties of afferent vessel or artery, and recipient cavity or auricle (and it has been shewn that it does both), is it not highly probable that it acts also as the propulsive agent or ventricle? In the pulmonary and general systems the auricle stands first, the ventricle second, and the artery third; and, as the spleno-hepatic vein performs in the hepatic system the duties of the *first* and *third,* which conjecture appears *primâ facie* most reasonable—that it does, or does not act as the *second* also?

31. The spleno-hepatic vein may be compared to a *tree;* for like a tree it is composed of roots, trunk, and branches. The spleen is the *roots;* the splenic vein, and its continua-

tion the portal vein, are the *trunk;* and the ramifications of the portal vein to their terminations in the portal plexuses, are the *branches.*

32. The spleen is composed of the branches of the splenic artery, their capillary terminations, and of the roots of the spleno-hepatic vein; but *chiefly* and *essentially* of the latter, which are remarkable for their large size, tenuity, and distensibility. The trunk and branches of the spleno-hepatic vein, as well as the roots, or spleen, are also highly distensible. The roots, or spleen, are contained in an elastic capsule; and the branches are surrounded by sheaths of loose cellular membrane (prolongations from Glisson's capsule) which accompany the branches through the portal canals* even to the terminations of the former in the portal plexuses.

33. The distensibility of the whole vein, roots, trunk, and branches,—the roots being surrounded by an elastic capsule,—and the branches by loose cellular sheaths, are sure indications that the degree of distension of the spleno-hepatic vein, or the quantity of portal blood it contains at different times, is subject to great variation. If the spleen were surrounded by an "*aponeurotic*" and therefore unyielding membrane, it could not suffer distension; and if the branches of the spleno-hepatic vein in the liver were like the *supra-hepatic* veins simple canals, they could not suffer distension: and under those circumstances the vein, at least the roots and branches, would contain at all times the same quantity of blood; and could not then perform those important duties which we are endeavouring to shew that it fulfils. But *Glisson's capsule* and the *splenic capsule* are proofs that it does contain a varying quantity of blood; for they are obviously provisions to allow of its distension; and could be of no use if the quantity of portal blood were always the same. It has indeed been matter of actual observation with some physiologists that the size of the spleen (or in other words the degree of distension of the first portion or roots of the spleno-hepatic vein) varies very

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* Each portal canal, in addition to a branch of the spleno-hepatic vein, contains a branch of the hepatic artery and a biliary duct.

considerably at different times in the same animal: from which variation in the size or distension of the spleen, and because the organ consists chiefly of venous roots, Bèclard justly remarked that in "texture and phenomena" it closely resembles the *penis.*

34. But although the quantity of portal blood contained in the spleno-hepatic vein is subject to great variation, the degree of distension of any one of the three divisions of the vein, roots, trunk, and branches, is at all times necessarily proportionate to that of either of the other two. For it is manifest that the trunk of the vein can never be at the maximum of distension when the roots and branches are not; or the branches when the trunk and roots are not; or the roots when the trunk and branches are not: and the same remarks apply equally to the medium and minimum degrees of distension.

35. As the roots, trunks, and branches of the spleno-hepatic vein are distensible, it *follows that they must also possess the power of contraction.* The distension of the vein is produced by the in-pouring of blood from the splenic artery, gastric, duodenal and mesenteric veins, and of fluids from the gastric and duodenal veins. When the vein is moderately distended the addition of more blood and fluids would *increase* that distension, and could not by any possibility have the effect of *diminishing* it. How then could the degree of distension *vary,* if the vein were not contractile as well as distensible? To be sure it might go on varying by constantly *increasing* until some part or other of the vein gave way, when fatal hæmorrage would be produced; but any *diminution* of the degree of distension could not take place if the vein were not contractile.

36. It is no less certain therefore that the spleno-hepatic vein is contractile than that it is distensible. Its contractility is a *vital* property: its distensibility a physical one. The distension of the vein is consequently *passive,* and its contraction *active.* When the distension has reached a certain point, contraction takes place; and the natural and necessary effect of that contraction is, *what nothing else can accomplish,* THE PROPULSION OF THE PORTAL BLOOD THROUGH THE

THREE DIVISIONS OF THE HEPATIC SYSTEM INTO THE RIGHT AURICLE.

37. *The action of the spleno-hepatic vein is like that of the auricles and ventricles, intermittent: like them it suffers distension and then contracts: but as its distension is far slower and less frequent than theirs, so also is its contraction.*

38. The frequency of the action or contraction of the spleno-hepatic vein is necessarily dependent on the rapidity of its distension; and also on the quality as well as quantity of the fluids which enter it by the gastric and duodenal veins.

39. The contractility of the spleno-hepatic vein is easily called into action by Fear: and it is owing to this circumstance that we can frighten away *hiccup;* and that *fright* is the most frequent exciting cause of *Epilepsy.*

40. That the spleno-hepatic vein propels the portal blood through the hepatic system is further proved by the much greater size of the *spleen* relatively to the liver in man than in quadrupeds. It is, perhaps, not over-rating the weight of the spleen in man to estimate it at about one-sixth of the weight of the liver: but in quadrupeds it is only one-twelfth, one-fourteenth, or one-sixteenth. Owing to man walking on two legs, and quadrupeds on four, the axis of the trunk, and therefore the direction of the vessels through the liver, are *vertical* in the former and *horizontal* in the latter; and, as a greater power is needed to propel the portal blood vertically than horizontally, so does the spleno-hepatic vein of the man require a larger proportionate quantity of roots, or spleen, than the spleno-hepatic vein of the quadruped.

41. If the relative size of the spleen to the liver were the same in quadrupeds as in man, the impetus which the contraction of the spleen would give to the portal blood would be too great: and the propulsion of the blood through the portal plexuses and hepatic veins into the right auricle would be too rapidly effected. If, on the other hand, the relative size of the spleen to the liver were no greater in man than it is in quadrupeds, the impetus communicated to the portal blood by the contraction of the spleen would be too little;

and its propulsion through the portal plexuses and hepatic veins would be too slowly and with too much difficulty effected. In quadrupeds the flow or passage of blood through the liver is but little influenced by gravitation: in man gravitation is, most commonly, directly opposed to it.

42. Let us, for the sake of argument, suppose that the spleno-hepatic vein had no roots; but that still it performed the duties of recipient cavity, propulsive agent, and afferent vessel; and that we were told that although it answered the purposes of recipient cavity and afferent vessel extremely well (which it would, just as well without the spleen as with it), it was not very efficient as a propulsive agent. Suppose that we were then desired to set about altering and improving the spleno-hepatic vein so as to make it better adapted and more capable to propel the portal blood through the liver. Could the ingenuity of man contrive any thing so well calculated to effect that object as the spleen is? Yet how simple the contrivance! Merely fitting some venous roots on to the end of the venous trunk;—increasing or diminishing their proportion to the liver according as the usual direction of the hepatic vessels is more or less vertical;—endowing them with the same property of vital contractility as the trunk and branches already possess;—and lastly, enclosing them in an elastic capsule to moderate their distension, and yet permit both of their distension and contraction, in proportion as the trunk and branches distend and contract.

43. Physiologists have often done the *reverse* of this; that is, *removed* the roots of the spleno-hepatic vein; and, in general, no serious immediate consequences have resulted.—A few rare instances indeed are recorded of the partial and even of the entire loss of the spleen in the human subject; in all of which it is stated that shortly after the wounds of the abdominal parietes had healed, the health of the individuals was as perfect as before. But how long they lived with only a part of the spleen, or none at all; and whether they ultimately died of enteritis, or of hepatic disease, or of affections not produced by the accident, are matters upon which no information is afforded us.

44. It is obvious why loss of the spleen is not fatal, nor

productive of any serious immediate effects. It has been already stated that the spleen is essentially only the roots of the spleno-hepatic vein, the trunk and branches of which vein as well as the roots possess the property of vital contractility. When the spleen is removed, the roots of the spleno-hepatic vein only are removed. The trunk and branches are left behind: and the loss of the roots is not followed by the loss of vital contractility in the trunk and branches. The gastric, duodenal, and mesenteric veins terminate, not in the roots of the spleno-hepatic vein, but in the trunk. The vein therefore serves the purpose of recipient cavity just as well after the spleen has been removed as before. It is impaired only as a propulsive agent; and all the effect which the removal of the spleen produces is, that the blood is propelled through the liver less perfectly and freely than before: but still that propulsion *is* effected, although slowly and with difficulty, by the trunk and branches.

45. Although the spleen is not an organ essential to life,—although it is only a part of a vein,—and although physiologists have been accustomed to treat it somewhat contemptuously,—it is, nevertheless, entitled to some degree of consideration and respect: for, be it remembered, *the hepatic vascular system is the first of the three systems comprised in the Circulation of the Blood; the spleno-hepatic vein performs in that system the triple function of auricle, ventricle, and artery; and the spleen is not only a part of the spleno-hepatic vein, but it is the very first part.*

46. It is owing to three causes that it has not long since been demonstrated that the spleen is subservient to the Circulation and Propulsion of the Blood. First, to an over-estimate of the power of the left ventricle of the heart: secondly, to too implicit a faith in the perfectness and infallibility of Harvey's doctrine of the Circulation; and thirdly, to the vague and unreasonable notions commonly entertained concerning the absorption of fluids. It has only to be shewn that the fluids do not enter the Circulation by the *thoracic duct* to force the following concessions: First, that they must pass from the stomach and duodenum by the gastric and duodenal veins into the spleno-hepatic vein:

secondly, that much more diluted blood enters the heart by the hepatic veins than there is arterial blood sent through the cœliac and mesenteric arteries: thirdly, that it is a physical impossibility for the left ventricle to propel the portal blood through the portal plexuses and hepatic veins into the right auricle. These concessions made, to deny then that the spleno-hepatic vein possesses the property of vital contractility, or to assert that it does not propel the portal blood through the liver, would be tantamount to denying that the blood circulates; for it would be refusing to admit the action of a vessel on which the whole circulation is dependent; and which vessel, it must not be forgotten, has several remarkable peculiarities distinguishing it from an ordinary vein, and denoting that its office is not only different from, but more important than that of the veins in general.

47. It is now upwards of two centuries since Harvey proved that the blood circulates.* The evidence he adduced was irresistible; and his doctrine, after much opposition, became at length established. The physiologists of those days did not say to Harvey when he had promulgated his Theory —*We accept part; and we reject part. We admit the blood circulates; and that it enters the heart by the veins, and leaves it by the arteries. We admit that the right ventricle propels it through the lungs; and that the left propels it through all other parts and organs except the* LIVER; *and we make this exception because you neither prove, nor assign any reasons which make it appear at all probable, that the left ventricle does or can propel blood through* TWO CONSECUTIVE VASCULAR SYSTEMS. No: they at first, and for a long time, refused to acknowledge that the blood did circulate; and then, when they found they could no longer resist the mass of evidence by which the Circulation is proved, they ran into the opposite extreme, and admitted all Harvey desired; which was, first, that the blood circulates,—which was true; and secondly, that the heart is the sole organ or agent concerned in its propulsion,—which was false; *for the propul-*

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* Harvey first taught the Circulation of the Blood in 1619. His first book on the Circulation was published at Frankfort in 1628.

sion of the blood through the FIRST *of the three vascular systems comprised in the Circulation,—through the* LARGEST ORGAN *in the body,* THE LIVER, *is effected, not by the heart, but by the contraction of that* VEIN *of which the* SPLEEN *is the roots.*

48. As it has always been supposed since the adoption of Harvey's doctrine, that the heart propels the blood through the liver *after* birth, it has of course never been suspected that any other agent than the heart propels it through *before* birth. Doubts may have been entertained by those who have fancied there is a direct communication by means of *capillaries* between the uterine and placental vessels, whether the maternal heart or the fœtal heart propelled the blood from the placenta through the umbilical vein and fœtal liver into the fœtal auricles: but they who know that there is no such communication, and that the placenta is composed entirely of fœtal vessels (and who are therefore perfectly assured that the motion of the blood along the umbilical vein is not produced by the vis à tergo of the maternal left ventricle), have never called into question the capabilities of the fœtal ventricles; but have given the "*mighty vital organ*" as the heart has been termed, full credit for carrying on the entire Circulation before birth as well as after!

49. The following circumstances however unquestionably prove that the fœtal ventricles do not propel the blood from the placenta through the umbilical vein and fœtal liver into the fœtal auricles: First, the small size of the fœtal heart as compared with the liver and placenta; secondly, the great length of the umbilical cord; thirdly, the great tortuosity of the umbilical arteries, which renders them much longer even than the vein; fourthly, the small calibre of those arteries compared with that of the vein; fifthly, the two capillary systems, one in the placenta, the other in the fœtal liver; sixthly, the fact that more blood passes from the placenta through the umbilical vein to the fœtus, than from the fœtus through the umbilical arteries to the placenta (which is evidently the case because the blood being the *materiel* of the fœtal development and growth is constantly being deposited in all parts of the fœtal system); and lastly, because the

blood does get propelled through the fœtal liver when there is no heart as is proved by the acardiac fœtuses.

50. The hepatic vascular system is a distinct, perfect, and independent system, before birth as well as after: and as THE VEIN of which the *spleen* is the roots performs, *per se*, in that system after birth, the triple function of recipient cavity, propulsive agent, and afferent vessel (which triple function requires for its performance both in the pulmonary and general systems, an auricle, a ventricle, and an artery), so also does THE VEIN of which the *placenta* is the roots perform, *per se*, the same triple function in the hepatic system before birth.

51. The Placenta is essentially the roots of the UMBILICAL VEIN, just as the Spleen is essentially the roots of the SPLENO-HEPATIC VEIN. Both the spleen and placenta are composed of arterial branches, their capillary terminations, and venous roots; but chiefly and essentially of venous roots, remarkable for their large size, tenuity, and distensibility, and also for their *contractility*. There would have been no capillaries, nor arterial branches, either in the spleen or placenta, and the splenic artery and the umbilical arteries would have had no existence, if venous roots could have originated from nothing: but venous roots in all parts and organs originate from capillaries, and from capillaries only; and capillaries in all parts and organs, except the liver, proceed from arteries, and from arteries only; and it is simply and solely because a large congeries of venous roots cannot originate from a small number of capillaries, nor a large number of capillaries proceed from a small sized artery, that the splenic artery and the umbilical arteries are considerable sized vessels.

52. The Circulation after birth comprises three vascular systems, an hepatic, a pulmonary, and a general; but before birth it comprises only two, an hepatic and a general; for before birth the pulmonary system is a part of the general system,—the two auricles, owing to the *foramen ovale*, forming one recipient cavity; and the two ventricles, owing to the communication between the pulmonary artery and aorta by means of the *ductus arteriosus*, one propulsive agent.

53. Before birth the hepatic vascular system possesses

TWO SPLEENS; one intra-abdominal and permanent—the *spleen;* and one extra-abdominal and temporary—the *placenta.* Why the latter should ever have been regarded as a sort of *fœtal lungs,* which it still very generally is, I cannot comprehend; nor why the following analogies or resemblances between it and the spleen should so long have been overlooked. (1.) The spleen is composed of arterial branches, and venous roots, with their intervening capillaries; and so also is the placenta. (2.) The spleen is contained in an elastic capsule which sends prolongations through its interior. The placenta is also contained in an elastic capsule formed by the two layers of the decidua, and from the inner surface of which proceed prolongations analogous to those of the splenic capsule. (3.) The circumference of the spleen is more or less lobulated or fissured; and so also is the circumference of the placenta. (4.) The spleen receives very few and very small nerves. The placenta, it is believed, receives none. (5.) The splenic artery is remarkable for its tortuosity. The umbilical arteries are even more tortuous than the splenic. (6.) The spleen is connected with the liver by a vein, of which it (the spleen) is essentially the roots. The placenta is also connected with the liver by a vein, of which it (the placenta) is essentially the roots. (7.) At the transverse fissure of the liver these two veins, the spleno-hepatic and umbilical, are connected together by a large short branch, the *ductus communicans.* (8.) These two veins resemble each other, and differ from all other veins, by dividing and subdividing after the manner of arteries. (9.) The branches of both terminate in the same system of capillaries, the portal plexuses. (10.) The trunk and branches of the spleno-hepatic vein contain a diluted blood. The roots, as well as the trunk and branches of the umbilical vein also contain a diluted blood. (The dilution of the former has already been accounted for. The dilution of the latter is effected *previous* to its entering the placenta, by being deprived of its *fibrin,* which is deposited in the parietes of the uterus: and by this deposition the rapid growth and development of the uterus are produced which take place during the period of gestation.)

54. The spleen and placenta therefore, besides presenting a striking similarity in their external appearance, are of similar texture, and are connected with the same organ, the Liver, by a vein of which each is the roots. The trunks of the two veins are connected with each other; the branches of both terminate in the same system of capillaries; and each vein contains a diluted blood. With such facts as these before our eyes, we cannot help inferring that the vein, of which the placenta is the roots, performs a very similar function before birth to that which the vein, of which the spleen is the roots, performs after birth. It has been shewn that the spleno-hepatic vein performs in the hepatic system after birth, the triple function of recipient cavity or auricle, propulsive agent or ventricle, and afferent vessel or artery; and it is at once evident that the vein, of which the placenta is the roots, performs at least two parts out of three of that function before birth! It is the *recipient cavity*, for it receives blood from the uterine vessels, (veins,) and also a certain, though probably inconsiderable, quantity from the fœtus by the umbilical arteries, which commingles with the former in the roots of the umbilical vein. It is also the *afferent vessel*, for through it the blood passes *into* the liver; in which organ it divides and subdivides, and terminates in capillaries,—like the three other afferent vessels, the spleno-hepatic vein, pulmonary artery, and aorta.

55. But is it also the *propulsive agent?* Is it owing to the vital contractility of the vein, of which the placenta is the roots, that the blood which exudes into those roots from the uterine veins, and also that which the fœtal heart sends into them through the umbilical arteries, is propelled a distance of some twenty or thirty inches, and then through the fœtal liver into the fœtal auricles? Undoubtedly it is. The fœtal heart cannot effect that propulsion for reasons already given, and therefore the vein, of which the placenta is the roots, *must.* It is under the *necessity* of acting as propulsive agent, in addition to serving as the recipient cavity, and afferent vessel: and strange indeed would it be if it could officiate as *auricle* and *artery* and not as *ventricle* also; or as number *one*, and number *three*, and not as number *two!* To say

that it is not contractile, merely because we do not see or hear it contract, is idle and frivolous. . It *must* be contractile; and, in addition to that necessity, its close resemblance in so many particulars to the spleno-hepatic vein plainly shews that it is.

56. The TWO VEINS, however, in addition to their numerous analogies, have also their peculiarities which it is important not to overlook. The vein of which the placenta is the roots is *temporary;* the vein of which the spleen is the roots is *permanent.* The roots and the greater part of the trunk of the umbilical vein are *extra-abdominal;* the roots, trunk, and branches of the spleno-hepatic vein are all *within the abdomen;* and it is well they are, for the *spleen* would have been a very inconvenient external appendage! Nearly all the blood which enters the umbilical vein enters it at the *roots:* the greater part of the portal blood enters the *trunk* of the spleno-hepatic vein by the gastric, duodenal, and mesenteric veins. The roots of the spleno-hepatic vein receive blood from the splenic artery only: the roots of the umbilical vein receive blood not merely from the umbilical arteries, but also from the uterine veins. The blood of the umbilical vein is diluted *before* it enters the vein: the portal blood is diluted after. The spleen possesses numerous lymphatics: the placenta, none.

57. The heart being supposed capable of propelling the blood through the liver—the spleen and placenta, instead of being regarded as organs subservient to the circulation of the blood, are generally believed to be for the purpose of *altering the blood* which passes through them. It is hardly necessary to remark that no *evidence* whatever has been adduced to prove that any change *is* effected on the blood by the spleen or placenta; nor, indeed, have any *reasons* ever been assigned to shew that the blood *requires* to be altered by either of those organs. The blood which exudes from the vessels of the uterus into the placenta has been deprived of its fibrin in the former; that is *one* change: it is supposed to be altered again in the placenta; that is the *second* change: next it is altered in the liver by the bile being eliminated from it; which is the *third* change: and lastly, the

blood which returns to the placenta through the umbilical arteries is believed to have become *deteriorated* in the fœtus, and so is sent back to the placenta to get rid of its bad qualities, and acquire good ones; which is the *fourth* change! The first change is an intelligible and sensible change; the fibrin of the blood is not wanted by the fœtus, but is required to produce an increased muscular development of the uterus. The third change resulting in, or produced by, the elimination of bile, is a very important change, and one that we know does take place. But what are the grounds for believing that the second and fourth changes do actually occur? Why suppose the *placenta* effects any change upon the blood which enters it from the uterine veins; or upon that which returns to it from the fœtus by the umbilical arteries? The former has just been deprived of its *fibrin;* and before it can enter the fœtal heart *bile* is eliminated from it in the liver: What occasion is there for any *intermediate* change to be effected in it by the placenta? The dilution of the blood in the uterus by the deposition of fibrin is useful to the mother; the elimination of bile from it in the fœtal liver is useful to the fœtus; but why alter the blood between the uterus and the liver? Is it reasonable to suppose that Nature causes blood to exude from the maternal vessels into the fœtal so *imperfect* that it must undergo *two changes* before it is fit to enter the fœtal heart? And why believe that the blood which returns to the placenta through the umbilic arteries wants *mending?* What has happened to *it* to make it different from, or worse than, the blood in the external iliacs, or in any other arteries of the fœtus? And if it be of precisely the same quality, which it manifestly is, what alteration or emendation does the former require which the latter does not?

58. There is no reason whatever for believing that *any* change is effected in the blood by the placenta. That organ is composed of arterial branches, capillaries, and venous roots. Neither arterial branches, nor venous roots can alter the blood which passes through them, any more than arterial or venous *trunks*. If any change then be effected in the blood by the placenta it must be in the capillaries. Now

blood to be *altered* must have some principle or principles either added to it, or taken from it, or both. But the placenta consists almost wholly of sanguiferous vessels (arterial branches, capillaries, and venous roots); the only extra-vascular tissue in it is the prolongations from the decidua; how then can any principle or principles be *added* to the blood in the capillaries of the placenta? Again, there is no *excretory duct;* whatever enters the placenta passes through the trunk and branches of the umbilical vein; how then is it possible for any thing to be *eliminated* from the blood in the capillaries of the placenta? And, if nothing be either added to or taken from the blood, how can it become *changed?*

59. If the blood propelled through the umbilical arteries were really a deteriorated blood, and required altering in the placenta by the addition of *oxygen,* or the subtraction of *carbonic acid,* or both, or in any other way, surely those arteries ought to allow such deteriorated blood to be sent *direct* to the placenta: but instead of that, they *increase the distance* it has to go to get into the placenta, (which one would suppose was quite *far* enough off,) and *impede its course* as much as they well can, by winding round and round the umbilical vein! This *tortuosity* of the umbilical arteries alone plainly indicates that the blood which passes through them is not sent to the placenta for the purpose of being changed. As I have already remarked, those arteries would never have existed if venous roots did not invariably, and therefore *necessarily,* originate from capillaries; *and the great purpose they serve is—not to convey a damaged blood to the placenta—but to be split up into capillaries for the roots of the umbilical vein to originate from.*

60. Nearly the same remarks apply to the *spleen and splenic artery* as to the *placenta and umbilical arteries.* No change is effected on the blood in its progress through the capillaries of the spleen; and therefore the blood in the *roots* of the spleno-hepatic vein is during life of a florid appearance. As the spleen consists almost wholly of sanguiferous vessels, it can *add* nothing to the blood; and as it has no excretory duct, it can *eliminate* nothing from it.* The spleen

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* It is necessary to observe that numerous *lymphatics* are contained in the

therefore, like the placenta, being incapable of either adding any principle to, or of taking any from the blood, can effect no *change* upon it. The use of the splenic artery is similar to that of the umbilical arteries; that is, *it is given off from the cœliac for the purpose of being broken up into capillaries for the roots of the spleno-hepatic vein to originate from.*

61. The splenic artery is like the umbilical arteries remarkable for its *tortuosity.* It does not indeed entwine itself round the splenic vein; but still it is an exceedingly tortuous vessel. The tortuosity of the umbilical arteries is evidently for the purpose of *minimising* the quantity of blood sent back to the placenta; for every drop over and above that required for the nutrition and growth of the placenta is sent on a bootless errand. The tortuosity of the splenic artery serves a similar purpose; it greatly impedes the flow of blood through that vessel, and thereby prevents any very considerable or undue quantity from passing through it into the spleno-hepatic vein; for as the splenic artery is, for reasons already given, a large vessel, a very great quantity of blood would necessarily pass through it if it were straight instead of tortuous. Judging from the extreme tortuosity both of the splenic and umbilical arteries, there can be but little doubt that the quantity of blood which passes through them is very much less than we have long been accustomed to suppose.

62. There cannot be a more erroneous supposition than the one recently advanced by Mr. Stevens, to the effect that the arterial or oxygenised blood which passes through the splenic artery is *wanted to "vitalise" the portal blood, or to make it more "stimulating"* or *"better adapted for the secretion of the bile."* With as much reason might we suppose that the blood which is sent through the umbilical arteries

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spleen; and that they have been thought to perform a more important function there than in other organs or parts. It is probable however that the lymphatic vessels in the spleen as elsewhere, not excepting even the lacteals, are merely a sort of *gleaners* which pick up or receive what exudes from or is left by the *veins;* and that the lymphatic system is entirely subservient to the venous. But be this as it may, the lymphatics of the spleen are not more numerous than those of the *penis,* an organ which like the spleen consists chiefly of *veins;* and there are no reasons which ought to lead us to suppose that the lymphatics of the former perform a function different from or more important than the same vessels in the latter. The absence of lymphatics in the placenta, moreover indicates that those vessels are not *essentially* connected with the office of the spleen.

is wanted to vitalise the blood in the umbilical vein to make *it* better adapted for the secretion of the bile; and to say, that the use of the spleen is to divert blood from the splenic artery into the portal vein, is just as unreasonable as it would be to say that the use of the placenta is to divert blood from the umbilical arteries into the umbilical vein.*

63. If the spleen were for the purpose of effecting some *change* upon the blood which passes through it, and thereby to render the portal blood better adapted for the secretion of the bile than it would otherwise be,—or if that, or any similar end were answered by the blood which is sent through the splenic artery being diverted *unchanged* into the portal vein, we ought to find the size of the spleen to bear pretty nearly the same relative proportion to that of the liver in quadrupeds as in man; for there is no assignable reason why the portal blood of a man should need the addition of a certain quantity of splenic blood, and the portal blood of a quadruped (for instance, a pig, which like man is omnivorous) require only half, or perhaps less than half such certain quantity. This fact of the much greater proportionate size of the spleen to the liver in man than in quadrupeds, is irreconcilable with any other explanation of its use than that already given—namely, that the roots of the spleno-hepatic vein, or spleen, co-operate with the two other divisions of the vein, the trunk and branches, in the propulsion of the portal blood through the portal plexuses and hepatic veins into the right auricle.

64. Before birth the liver is remarkably large, and the spleen as remarkably small. The latter organ therefore bears a much less proportion to the former before birth than it does some time after; for after birth the liver, for a short time, actually diminishes in size; but on the other hand, the spleen, until it attains its full development, slowly but

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* Mr. Stevens enjoys the friendship of the Editor of the *Lancet*, who, to oblige him, advertises his (Stevens's) anatomical, physiological, and etymological crotchets concerning the SPLEEN as "discoveries"! nay, the Editor's tenderness for his friend is so great, that two letters which I wrote to the *Lancet* refuting the pretended discoveries were for several weeks *suppressed;* and, at last, a few *convenient* extracts only were made from them—I suspect under Mr. Stevens's own personal superintendence—and those extracts even were so wofully mutilated, and execrably printed (see *Lancet* for March 25), that I take this opportunity of openly disclaiming them.

constantly increases; so that the splenic artery after birth becomes larger than the hepatic, although before birth it is smaller. The reason the spleen is so small before birth is obvious: it is because there then exists another spleen, an extra-abdominal, and temporary one, the *placenta.* The fœtal liver does not require *two* spleens to propel the blood through it; and therefore the permanent spleen remains very small until after birth; at which period it is, and not before, that its real function commences.

65. In a former part of this paper (paragraph 17) it was intimated that there are some reasons for believing the *solids*, or the nutrient fluid derivable from the solids, take a similar course to the non-nutrient fluids—that is, pass through the three systems comprised in the Circulation, in their natural order of *hepatic*, *pulmonary*, and *general.* The non-nutrient fluids, as already observed, pass, not through the lacteals into the thoracic duct, but through the gastric and duodenal veins (and chiefly through the former) into the spleno-hepatic vein. There is no reason to suppose that they ever pass into the digestive tube as far as the jejunum, and so through the great mesenteric vein into the spleno-hepatic: indeed, their absorption, there can be no doubt, takes place chiefly from the stomach, for a ligature placed upon the pyloric extremity of that viscus does not much retard their disappearance from it.—The question then is, What course does the *nutrient fluid*—that fluid which is derived from the solid aliments, and which conveys the solid materials of the body into the sanguiferous vessels—take to get into those vessels? and where does it enter them?—Does it pass from the digestive tube into the lacteals and then through the thoracic duct into the left subclavian vein? or does it pass direct into the veins—that is, does it enter the *roots* of the mesenteric veins, and get conveyed by them into the spleno-hepatic vein, and so become a constituent of the *portal blood?* It must take one of those two courses; and the latter appears to me, on the following grounds, to be far the most reasonable view.—*Before birth* there is no continuity between the vessels of the uterus and those of the placenta. All the vessels of the uterus are uterine and maternal; and all the

vessels of the placenta are umbilical and fœtal. The placenta therefore is as completely a *fœtal* organ, as the uterus is a maternal one. Now *turpentine* injected into the umbilical arteries passes into the umbilical vein; and the same fluid injected into the uterine arteries passes into the uterine veins; and it cannot be made to pass (without the rupture of vessels) from the uterine arteries into the umbilical vein, nor from the umbilical arteries into the uterine veins. There are therefore no capillary vessels intervening between the uterine arteries and the umbilical vein, nor between the umbilical arteries and the uterine veins; and the diluted blood, which is the nutrient fluid supplied to the fœtus, must consequently *exude* from the uterine vessels (no doubt from the great uterine veins, or sinuses) into the roots of the umbilical vein. Thus, before birth, the blood, or nutrient fluid, containing the solid materials for the fœtal development and growth, enters the veins *direct*, and passes through the liver before it enters the heart. There is *then* no pulmonary system, and the nutrient fluid therefore passes from the hepatic into the general system, and it is important to remark, it passes *first* through the hepatic system. Now, as the nutrient fluid before birth enters the veins *direct* by exudation and passes through the liver before it enters the heart, is it reasonable to believe that the nutrient fluid after birth does *not* enter the veins direct by a similar process of exudation and does *not* pass through the liver before it enters the heart?—The opinion generally entertained is that the nutrient fluid derived from the solid aliments passes through the lacteals, mesenteric glands, and thoracic duct into the left subclavian vein; and that even the non-nutrient fluids also take this course. But if the nutrient fluid does pass from the digestive tube into the lacteals, and through the thoracic duct into the left subclavian vein, it is evident that it *misses* the hepatic system, which is the first system, and passes first through the pulmonary, and secondly through the general system; and only a part of it, namely, that propelled through the cœliac and mesenteric arteries, can ever arrive in the hepatic system at all; and then not until after it has been through the pulmonary and general systems. The course, calibre, and termination of the thoracic duct are also strongly opposed to the opinion that either the nutrient or non-nutrient fluids pass through the lymphatic system into the sanguiferous: and these considerations, collectively, appear to me to justify the belief that all fluids, nutrient, as well as non-nutrient, pass through the liver before they enter the heart; and therefore through the three systems of the Circulation in their natural order of hepatic, pulmonary, and general.

66. If the foregoing opinions be well founded—if the non-nutrient fluids pass through the gastric and duodenal veins, and the nutrient fluid through the mesenteric veins, into the spleno-hepatic vein, to be propelled first through the hepatic system by the spleno-hepatic vein, secondly through the pulmonary system by the right ventricle, and thirdly through the general system by the left ventricle—it follows, that the gastric, duodenal, and mesenteric veins are both distensible and contractile; for it is manifest that they must contain at different times a varying quantity of blood. There is, I imagine, no reason to doubt that *all veins* are more or less contractile*—with the exception, perhaps, of the hepatic veins in the hepatic system, (which are simple canals,) the pulmonary veins in the pulmonary system, and the cerebral sinuses in the general system; and it seems probable that the contractility, distensibility, and also the absorbing capabilities of veins in general, are proportionate to their *tenuity*, and greater therefore in the roots than trunks. But although I attribute to most of the veins or efferent vessels of the general system a contractile power, I am far from believing that venous contractility is continually co-operating with the vis à tergo in returning the blood to the heart by the superior and inferior venæ cavæ.—When *digestion* is at an end,—when the gastric, duodenal, and mesenteric veins, are not suffering distension from the exudation of fluids into them from the digestive tube, the vis à tergo is probably fully

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* "In spite of their thinness, the veins nevertheless consist, like the arteries, of three coats; but the structure of the middle one of these is different. In the veins it is not composed of elastic tissue as in the arteries; it is on the contrary made up of *fibres of fine organic muscular or contractile tissue*, which run in long spirals, and under appropriate stimuli, both contract the diameter of the vein and diminish its length."—Gulliver's Gerber, p. 296.

adequate to propel the blood through those veins into the spleno-hepatic vein: and the same power is no doubt also capable at all times of returning the blood to the right auricle by all the veins which contribute to form the superior and inferior venæ cavæ. But certain agencies, particularly *fear* and *cold,* have a striking influence over venous contractility, and consequently greatly accelerate the return of blood to the heart: as already stated, it is owing to the influence which the former has over the contractility of the spleno-hepatic vein, that *fright* is the most frequent exciting cause of Epilepsy.

67. I may, in conclusion, remark that the preceding theory of the uses of the spleen and placenta, or rather of the Two Veins of which they are essentially the roots, originated in an investigation into the nature of *Epilepsy.* The great venous turgescence of countenance which occurs in the paroxysms of that disorder, and which turgescence is sometimes so excessive that the blood will exude through the pores of the skin like sweat, led me to infer that an epileptic seizure was owing to something or other preventing the ingress of blood into the heart by the superior cava. The effects produced by the experiments of tying the superior cava alone and conjointly with the vena azygos convinced me that such really was the case. The question as to the nature of the internal process which takes place in Epilepsy then became definite—it was simply, how can the ingress of blood into the heart by the *superior* auricular opening be suddenly and temporarily prevented?—I thought by a sudden and temporary *rush* of blood into the heart by the *inferior* auricular opening. But what was to produce this rush of blood through the inferior auricular opening?—There was nothing directly connected with the *inferior cava* which could produce it.—Could it then be from the *cavæ hepaticæ?* It at once struck me that the *heart* had nothing to do with the propulsion of the portal blood through the liver: and that the organ with the unknown function produced the disease of the unknown nature.

6, Stonefield Street, Islington,
March 18, 1843.